[0286] In some embodiments, each detection electrode comprises a single type of capture probe. In others, a plurality of different capture probes (e.g. 2, 3 or 4, generally) can be used (with corresponding label probes with different redox potentials).

[0287] A preferred embodiment utilizes nucleic acids as the capture binding ligand. While most of the following discussion herein focuses on nucleic acids, as will be appreciated by those in the art, many of the techniques outlined below apply in a similar manner to non-nucleic acid systems as well, and to systems that rely on attachment to surfaces other than metal electrodes.

[0288] As outlined therein, the detection electrodes generally further include self-assembled monolayers (SAMs) as well. By "monolayer" or "self-assembled monolayer" or "SAM" herein is meant a relatively ordered assembly of molecules spontaneously chemisorbed on a surface, in which the molecules are oriented approximately parallel to each other and roughly perpendicular to the surface. A majority of the molecules includes a functional group that adheres to the surface, and a portion that interacts with neighboring molecules in the monolayer to form the relatively ordered array. A "mixed" monolayer comprises a heterogeneous monolayer, that is, where at least two different molecules make up the monolayer.

[0289] The present invention provides methods of detecting the presence or absence of target analytes in samples used generally for diagnosis of exogenous pathogens, nucleic acid based diseases and/or drug suitability, dosages, etc.

[0290] The general methods rely on loading the sample into the cartridge, closing the sample inlet port, and inserting the cartridge into the instrument (optionally adding a patient identifier barcode to the cartridge and scanning it in with a barcode reader). The instrument, comprising a CPU, then executes a number of operational steps to initiate and complete the appropriate assay and generate a patient report. FIGS. **33**A, **33**B, **33**C, and **33**D show an exemplary process run with the operational steps, also identifying the "actor" that accomplishes the steps. As will be appreciated by those in the art, there are a wide variety of assays that can be run on the systems of the invention.

1. A biochip cartridge comprising:

a) a bottom substrate comprising a printed circuit board (PCB) comprising:

i) an electrowetting grid of electrodes forming a droplet pathway comprising a plurality of electrowetting pads;

ii) an array of detection electrodes accessible to said droplet pathway, each comprising a self-assembled monolayer and a capture probe;

iii) a plurality of interconnections from said electrowetting grid and said detection electrodes; and

b) a top plate parallel to said bottom substrate and mated thereto to form a reaction chamber.

2. A biochip cartridge according to claim **1**, wherein said top plate comprises a conductive surface.

3. A biochip cartridge according to claim **1**, wherein said top plate comprises at least one fluid hole spatially corresponding to at least one of said electrowetting pads.

4. A biochip cartridge according to claim **1**, wherein at least one of said electrowetting pads comprises a dried assay reagent.

5. A biochip cartridge according to claim **1**, wherein said array of detection electrodes is in fluid communication with said droplet pathway.

6. A biochip cartridge according to claim **1**, wherein said biochip cartridge further comprises a liquid regent module (LRM) comprising:

i) a plurality of blisters comprising fluid assay reagents;

ii) a plurality of passageways in fluid communication with said blisters; and

iii) a sample inlet port in fluid connection with said reaction chamber.

7. A biochip cartridge according to claim **1**, further comprising an external housing comprising a latched cover for sealing said sample inlet port.

8. A biochip cartridge according to claim **7**, wherein said external housing further comprises electronic connections from said interconnections.

9. A biochip cartridge according to claim **1**, wherein said bottom substrate further comprises at least one amplification pathway comprising a plurality of electrowetting pads.

10. A biochip cartridge according to claim **1**, wherein said bottom substrate further comprises a plurality of amplification pathways, each comprising a plurality of electrowetting pads.

11. A biochip cartridge according to claim **6**, wherein said LRM further comprises an aliquot of magnetic capture beads.

12. A biochip cartridge according to claim **6**, wherein at least one of said fluid passageways is configured to dispense a fluid assay reagent at a location remote from a blister comprising said reagent.

13. A biochip cartridge according to claim **7**, wherein said external housing is asymmetrically shaped.

14. A biochip cartridge according to claim **4**, wherein said dried assay reagent is selected from the group consisting of: dNTPs, PCR primers, a nucleic acid polymerase, an exonuclease, labelled signaling probes, and a combination thereof.

15. A biochip cartridge according to claim **7**, wherein said external housing further comprises a cartridge identification tag.

16. A biochip cartridge according to claim **6**, wherein at least one of said fluid assay reagents contained in said plurality of LRM blisters is selected from the group consisting of: water, an immiscible fluid, a lysis buffer, a binding buffer, an elution buffer, and a reconstitution buffer.

17. A biochip cartridge comprising:

a) a bottom substrate comprising:

i) a printed circuit board (PCB) comprising:

1) an electrowetting grid of electrodes forming a droplet pathway comprising electrowetting pads, wherein at least one of said pads comprises a dried reagent;

2) an array of detection electrodes, each comprising a self-assembled monolayer and a capture probe, wherein said detection electrodes are accessible to said droplet pathway;

3) a plurality of interconnections from said electrowetting grid and said detection electrodes;

b) a top plate parallel to said bottom substrate and mated thereto to form a reaction chamber, said top plate comprising at least one fluid hole spatially corresponding to said at least one pad comprising said dried reagent;